GTE-ERS
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02040

F.W. BELL
CG-100D
GUN PLUS

MAINTENANCE / SERVICE
MODEL CG-100D GUN PLUS

F.W. BELL, INC.
6120 HANGING MOSS RD.
ORLANDO, FL 32807
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TWX. (810) 853-3115

ECO
5/8/89

UN-01-132

GUN PLUS MAINTENANCE / SERVICE

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN CONTAINED IN THE OPERATING INSTRUCTIONS.

I. INTRODUCTION:

A. Included in this section are procedures for battery installation, calibration, and troubleshooting. General maintenance of the Gun includes periodic cleaning and inspection. To clean, wipe the unit with a damp cloth, make sure the core and aperture are kept free from dirt and foreign substances.

II. BATTERY INSTALLATION:

A. CAUTION: If the Gun is not to be used for an extended period, it is recommended that the batteries be removed to protect the unit.

B. There are four "AA" alkaline batteries that supply 6V operating power to the Gun (See Figure 1). A "Battery Low" indicator, located on the Liquid Crystal Display (LCD), will appear when the batteries require replacement.

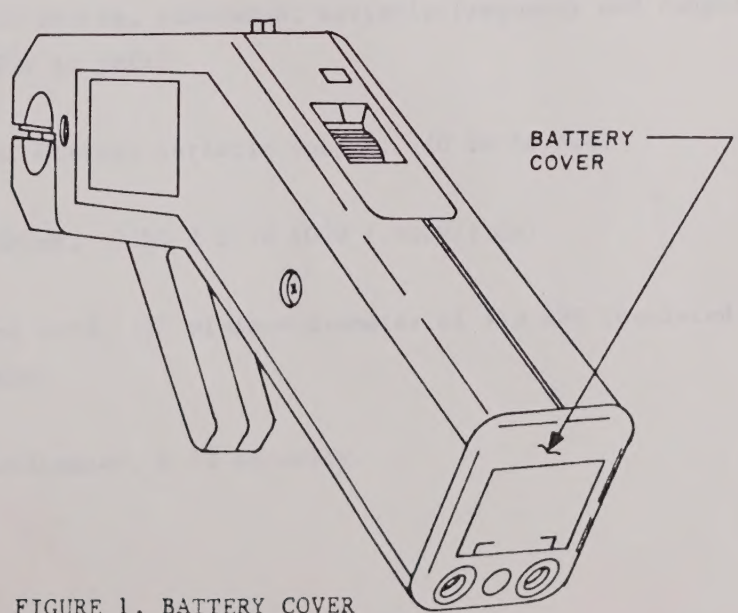


FIGURE 1, BATTERY COVER

III. CALIBRATION:

A. Complete calibration of the F.W. Bell, Inc. Current Gun Plus is accomplished by adjustment of 3 trimming potentiometers. These potentiometers are accessible, without disassembly, through holes in the plastic case located under Model/Logo Label, as shown in the diagram, Figure #3.

B. DESCRIPTION OF ADJUSTMENTS:

1. Coarse Zero adjustment to null-out initial dc voltage offsets and to set the null at the center of travel of the zero adjustment thumbwheel.

2. Output Calibration adjustment sets the sensitivity of the output amplifier so that the output voltage falls within the specified accuracy. The output sensitivity is 1.0V for 100A.

3. Read-out Calibration adjustment sets the 3½ digital meter of the Gun to agree with the output reading.

C. EQUIPMENT REQUIRED:

1. AC Current Source, sine-wave, variable frequency and output. (0.10: 50Hz to 1kHz)

2. DC Current Source, variable output. (0 to 10 Adc)

3. Current Shunt, 0.5Ω ± 0.1% 100W (.500V/1.0A)

4. Fifty-turn coil, 18" minimum diameter of #15 AWG insulated magnet wire.

5. Digital voltmeter. 0.1% accuracy.

D. EQUIPMENT SET-UP:

See Figure 2.

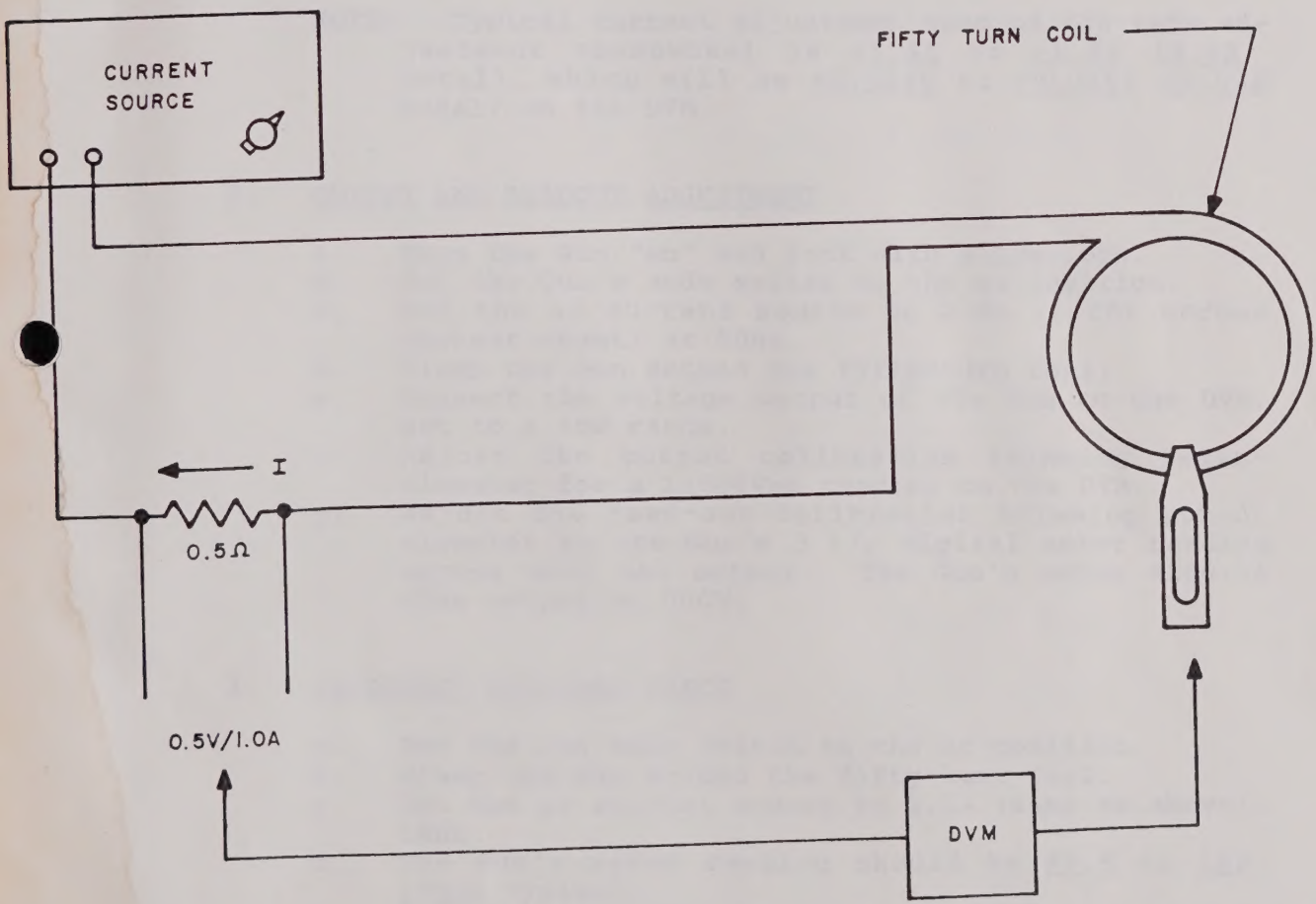


FIGURE 2, EQUIPMENT SET-UP

E. STEP BY STEP ADJUSTMENT PROCEDURE FOR ADJUSTMENT LOCATION, SEE FIGURE #3).

1. COARSE DC ZERO ADJUSTMENT

a. Turn the Gun "on" and lock with slide-lock.
b. Set the Gun's mode switch to the dc position.
c. Connect the Gun's output to the DVM, set to a low dc voltage range.
d. Adjust the coarse zero trimming potentiometer until a numerically equal positive and negative dc voltage reading is obtained at each stop of the zero adjustment thumbwheel.

NOTE: Typical current adjustment span of the zero adjustment thumbwheel is +1.8A to -1.8A (3.6A total), which will be +0.018V to -0.018V (0.036 total) on the DVM.

2. OUTPUT AND READOUT ADJUSTMENT

a. Turn the Gun "on" and lock with slide-lock.
b. Set the Gun's mode switch to the ac position.
c. Set the ac current source to 2.0A (1.00V across current shunt) at 50Hz.
d. Clamp the Gun around the fifty-turn coil.
e. Connect the voltage output of the Gun to the DVM, set to a low range.
f. Adjust the output calibration trimming potentiometer for a 1.000Vac reading on the DVM.
g. Adjust the read-out calibration trimming potentiometer so the Gun's 3 $^{1}/_{2}$ digital meter reading agrees with the output. The Gun's meter =100.0A when output =1.000V.

3. FREQUENCY RESPONSE CHECK

a. Set the Gun mode switch to the ac position.
b. Clamp the Gun around the fifty-turn-coil.
c. Set the ac current source to 2.0A (same as above), 1kHz.
d. The Gun's meter reading should be 99.5 to 102, 100.4 typical.
e. Set the ac current source to 2.0A (same as above), 400Hz.
f. The Gun's meter reading should be 97.8 to 99.3, 98.5 typical.

4. DC CALIBRATION CHECK

a. Set the dc current source to 2A (1.000V across current shunt).
b. Set the Gun's mode switch to the dc position.
c. Remove the Gun from the coil.
d. Turn "off" and "on" to stabilize the core.
e. Clamp the Gun on the fifty-turn coil.
f. Note the readings of the output and the meter of the Gun, the errors of both should be less than ±1.0A (1.0%). Typically the output error is ±0.5A.

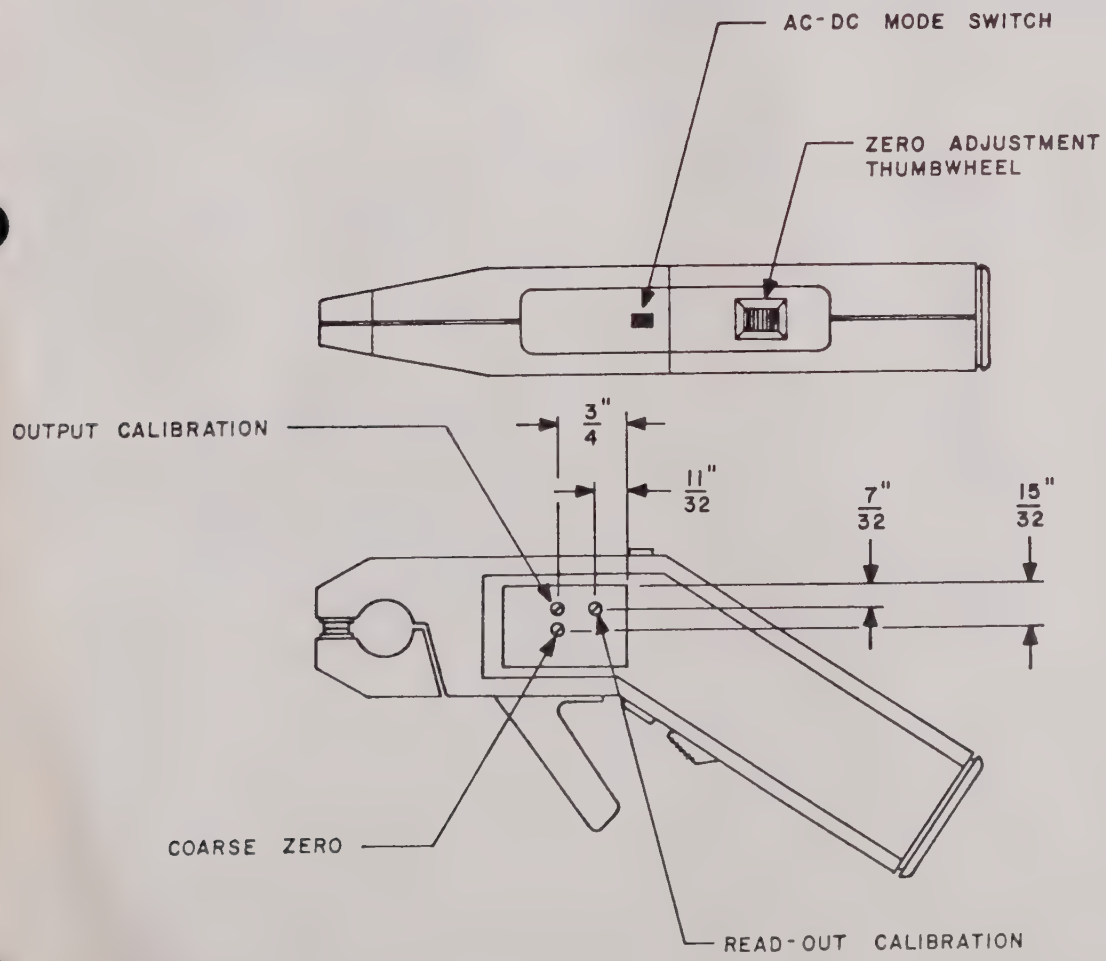


FIGURE 3, TRIM ADJUSTMENT LOCATIONS

IV. TROUBLSHOOTING:

A. Before referencing the following troubleshooting guide for the Gun, check the obvious potential source of problems such as the ON/OFF switch, power source (batteries), and loose or incorrect connections to the Gun and peripheral equipment.

B. The following troubleshooting guide is keyed to the schematics or wiring diagrams contained in this manual. The troubleshooting guide is presented by test and symptom with the related possible cause.

IF IT IS DETERMINED THAT THE CORE, COIL, OR SENSOR IS DEFECTIVE, RETURN THE PROBE TO THE MANUFACTURER. THESE PARTS ARE NOT FIELD REPLACEMENT PARTS.

TROUBLESHOOTING GUIDE

TEST AND SYMPTOM	POSSIBLE CAUSE
1. INITIAL	
Low battery indicator is on when unit is turned on.	Low batteries, Q101, IC-102.
No output or meter reading low battery indicator off.	Dead batteries, Q2, CR3, C4.
Unit will not turn off.	S3, IC3, Q2, CR5.
Batteries discharging rapidly.	S2, C3.

TROUBLESHOOTING GUIDE (CONTINUED)

TEST AND SYMPTOM	POSSIBLE CAUSE
2. OUTPUT/METER TESTS (No Input Current)	
Cannot vary output with thumb zero knob.	No Hall Generator control current. Check voltage across R17 (=0.30Vdc), if not check IC1, CR7, Q1. *Open HG-1 (Should be 40Ω to 120Ω) measured from red to black leads of HG-1.
dc output and meter reading continues to drift after unit is turned on.	*Defective HG-1.
Output OK, meter drifts.	S1, IC-101, R103.
Cannot zero output with thumb zero knob.	Coarse Zero out of Cal, IC1, HG-1.
Output > ±3.0Vdc, meter is overranged and cannot adjust with thumb zero or coarse zero.	IC1, HG1**
Meter is overranged but output is OK.	IC-101, S1, R103.
Meter reading erratic, faint or missing LCD segments.	DS1, connections between LCD and PCB power.

TROUBLESHOOTING GUIDE (CONTINUED)

TEST AND SYMPTOM	POSSIBLE CAUSE
Excessive noise @ output. should be < 2.0mVac.	IC1, C7, HG-1**
dc readings OK but ac incorrect.	S1, C2, CR1, IC1.
3. HOLD CIRCUIT TESTS	
Meter held at one reading and output is OK.	CR4, IC3.
Meter reading is not held for approximately 5 seconds.	C4, IC3, CR5, CR3.
4. CORE DEMAGNETIZING TEST	
Turning unit on and off does not remove the dc residual in the core. (Typical < 0.2A)	S2, C3, L1.
5. FREQUENCY TEST	
Output and meter reading correct at 60Hz but out of tolerance at at 1kHz.	C1 open, core damaged.

* - If the Hall Generator is open, shorting the red and black leads (points P20 and P23 at the printed circuit board) will cause the correct voltage reading across R17 (= 0.30Vdc).

** - If the Hall Generator is defective, shorting the yellow and blue leads (points P21 and P22 at the printed circuit board), will cause a zero output to be obtained by adjustment of the thumb or coarse zero controls. The noise level on the output will decrease to <3.0mVac.

V. PARTS LIST:

A. This section contains a parts list and information on how to obtain parts. The parts list describes the part, gives the part or stock number and recommended quantity.

B. HOW TO OBTAIN PARTS:

1. Parts may be ordered from the factory or authorized representatives. For prompt and efficient handling of your order, include the following information:

a. Quantity
b. Part or Stock No.
c. Description
d. Reference designation
e. Unit Model No.

TABLE 1 ANALOG PCB ASSEMBLY

REF	DESCRIPTION	PART OR STOCK NO.	TOT QTY	REC QTY	NOTE
A1	ANALOG & POWER PCB ASSEMBLY, FIGURE 4	ONLY REPLACEABLE PARTS	REF		
C1	CAP, MONO CER, 0.0047µf	25530	1	1	
C2	CAP, ELECT, 10µf @ 16V	23262	1	1	
C3	CAP, ELECT, 4.7µf @ 16V	23260	1	1	
C4	CAP, TAN, 0.68µf @ 35V	25690	1	1	
C5	CAP, CER, 270Pf	25182	1	1	
C6	CAP, ELECT, 22µf @ 10V	23065	1	1	
C7	CAP, TAN, 56µf @ 6V	25640	1	1	
CR1	DIODE, IN914	28015	4	2	
CR2	DIODE, 1N914	20815	REF		
CR3	DIODE, IN914	20815	REF		
CR4	DIODE, 1N914	20815	REF		
CR5	DIODE, IN270 GERMANIUM	27990	2	2	
CR6	DIODE, IN270 GERMANIUM	27990	REF		
CR7	DIODE, CONSTANT CURRENT	29600	1	1	
HG1	CORE ASSEMBLY (NOT SHOWN)	FOOTNOTE "A"			A
L1					

A IF THE CORE, COIL, OR HALL GENERATOR IS DAMAGED OR FAILS, RETURN TO THE FACTORY OR AUTHORIZED SERVICE CENTER. THESE ARE NOT FIELD REPLACEABLE PARTS.

TABLE 1 ANALOG PCB ASSEMBLY

TABLE 1 ANALOG PCB ASSEMBLY (CONT.)

REF	DESCRIPTION	PART OR STOCK NO.	TOT QTY	REC QTY	NOTE
IC1	IC, QUAD OP-AMP LM-324	30020	1	1	
IC2	IC, HEX INTR "CMOS" 4069B	30080	1	1	
IC3	IC, QUAD ANALOG SW "CMOS" 4016	30075	1	1	
Q1	TRANSISTOR, 2N4126	29080	2	1	
Q2	TRANSISTOR, 2N4126	29080	REF		
R1	RES, MTL. FILM, 5.11K, 1%, 1/8W	15112	2		
R2	RES, MTL. FILM, 5.11K, 1%, 1/8W	15112	REF		
R3	RES, MTL. FILM, 165K , 1%, 1/8W	15129	2		
R4	RES, MTL. FILM, 165K , 1%, 1/8W	15129	REF		
R5	RES, CER. (POT) 50KΩ , COARSE ZERO	22055	1	1	
R6	RES, CARBON FILM, 2.2K, 5%, 1/4W	11541	2		
R7	RES, CARBON FILM, 2.2K, 5%, 1/4W	11541	REF		
R8	RES, PANEL MTU. (POT) 200Ω	21300	1	1	
R9	RES, MTL. FILM, 100K, 1%, 1/8W	15130	1		
R10	RES, MTL. FILM, 97.6K, 1%, 1/8W	15145	1		
R11	RES, MTL. FILM, 6.49K, 1%, 1/8W	15131	2		
R12	RES, MTL. FILM, 6.49K, 1%, 1/8W	15131	REF		
R13	RES, MTL. FILM, 11.8K, 1%, 1/8W	15156	1		
R14	RES, CER. (POT), 2KΩ CAL.	22059	1	1	

TABLE 1 ANALOG PCB ASSEMBLY (CONT.)

TABLE 1 ANALOG PCB ASSEMBLY (CONT.)

REF	DESCRIPTION	PART OR STOCK NO.	TOT QTY	REC QTY	NOTE
R15	RES, CARBON FILM, 5.1K, 5%, 1/4W	11550	1		
R16	RES, CARBON FILM, 6.2K, 5%, 1/4W	11552	1		
R17	RES, MTL. FILM, 12.1Ω , 1%, 1/8W	14877	1		
R18	RES, CARBON FILM, 10M, 5%, 1/4W	11628	1		
R19	RES, CARBON FILM, 1M , 5%, 1/4W	11605	2		
R20	RES, CARBON FILM, 100K, 5%, 1/4W	11581	1		
R21	RES, CARBON FILM, 1K , 5%, 1/4W	11533	1		
R22	RES, CARBON FILM, 1M , 5%, 1/4W	11605	REF		
R23	RES, CARBON FILM, 510K, 5%, 1/4W	11598	1		
S1	SWITCH, SLIDE DPDT	33701	1	1	
S2	SWITCH, SNAP ACTION	33860	2	1	
S3	SWITCH, SNAP ACTION	33860	REF		
SA1	JACK ASSEMBLY	SUB-ASSY 3011	1	1	
W1	JUMPER STRIP, 3 COND.	52245	2	1	
W2	JUMPER STRIP, 3 COND.	52245	REF		
MP1	STAND-OFF, (SWITCH BUSHING)	41382	1	1	
MP2	SCREW 4-40 x 3/4" PPHMS	45095	1	1	
MP3	NUT/LOCKWASHER 4-40	46450	1	1	

TABLE 1 ANALOG PCB ASSEMBLY (CONT.)

REF	DESCRIPTION	PART OR STOCK NO.	TOT QTY	REC QTY	NOTE
MP4	BUTTON, SW	39400	1	1	
MP5	SPRING, SW	47960	1	1	
MP6	BLOCK, FOAM	39705	1	1	
MP7	HOLDER, BATTERY	35710	1	1	

TABLE 1 ANALOG PCB ASSEMBLY (CONT.)

TABLE 2 DIGITAL DISPLAY PCB ASSEMBLY

REF	DESCRIPTION	PART OR STOCK NO.	TOT QTY	REC QTY	NOTE
A2	DIGITAL DISPLAY PCB ASSEMBLY, FIGURE 5	ONLY REPLACEABLE PARTS	REF		
C101	CAP, CER. DISC., 180 Pf @ 50V	25180	1	1	
C102	CAP, MYL., 0.1µf @ 100V	25045	2	1	
C103	CAP, MYL., 0.1µf @ 100V	25045	REF		
C104	CAP, MYL., 0.47µf @ 100V	25055	1	1	
C105	CAP, MYL., 0.22µf @ 100V	25050	1		
DS101	LIQUID CRYSTAL DISPLAY	30540	1	1	
IC-101	IC, A/D CONV., ICL7116 "CMOS"	30078	1	1	
IC-102	IC, QUAD EXOR., 4030 "CMOS"	30085	1	1	
Q101	TRANSISTOR, 2N4124	29070	1		
R101	RES, CARBON FILM, 20K, 5%, 1/4W	11564			
R102	RES, CARBON FILM, 390K, 5%, 1/4W	11595			
R103	RES, TRIM POT, 100K	21930	1	1	

TABLE 2 DIGITAL DISPLAY PCB ASSEMBLY (CONT.)

REF	DESCRIPTION	PART OR STOCK NO.	TOT QTY	REC QTY	NOTE
R104	RES, CARBON FILM, 100K, 5%, 1/4W	11581	2		
R105	RES, CARBON FILM, 1M , 5%, 1/4W	11605	1		
R106	RES, CARBON FILM, 300K, 5%, 1/4W	11592	1		
R107	RES, CARBON FILM, 100K, 5%, 1/4W	11581	1		
R108	RES, MTL. FILM, 100K, 1%, 1/8W	15130	1		
R109	RES, MTL. FILM, 14.3K 1%, 1/8W	15158	1		
W101	JUMPER STRIP, 13 COND.	52240	2	1	
W102	JUMPER STRIP, 13 COND.	52240	REF		
MP101	FRAME, CONN.		1	1	
MP102	CONNECTOR, ZEBRA STRIP	39399	2	2	SET
MP103	CONNECTOR, ZEBRA STRIP		REF		
MP104	CLAMP, DISPLAY	39399	2	2	
MP105	CLAMP, DISPLAY	39399	REF		
MP106	SCREW, 3-48 x 1" PPH	44925	4	2	
MP107	SPACER, #4 x 0.625"	41384	4	2	
MP108	BUSHING, NYL.	48425	4	2	

TABLE 2 DIGITAL DISPLAY PCB ASSEMBLY (CONT.)

TABLE 3 FINAL ASSEMBLY

REF	DESCRIPTION	PART OR STOCK NO.	TOT QTY	REC QTY	NOTE
A_1	ANALOG & POWER PCB ASSEMBLY	SUB-ASSY 3033	1		
A_2	DIGITAL DISPLAY PCB ASSEMBLY	SUB-ASSY 3032	1		
B1-B4	BATTERY, 1.5V, ALK, SIZE AA	35930	4		
	HARDWARE				
	SCREW 4 - 20 x 3/4"	45140	1		
	SCREW 6 - 19 x 7/8"	45366	1		
	SCREW 6 - 19 x 1"	45385	1		
	HINGE PIN	48250	1	1	
	SCREW 4 - 24 x 5/16"	44995			
	WASHER, FIBER	47940			
MP109	LABEL, MODEL/LOGO, QB-1733	38925	1		B C
MP110	LABEL, FUNCTION, QB-1732	38926	1		
MP111	LABEL, BACK COVER, QB-1729	38923	1	1	
MP112	BACK COVER	~~38623~~ 39412	1	1	

TABLE 3 FINAL ASSEMBLY

REF	DESCRIPTION	PART OR STOCK NO.	TOT QTY	REC QTY	NOTE
MP113	BUTTON, LOCK (ON-OFF)	39401	1	1	
MP114	KNOB, POT (TO, R8)	39403	1	1	
MP115	SPRING, JAW	47961	1	1	
MP116	LENS, CLEAR	37122	1	1	
	THE MODEL/LOG LABEL TAKEN OFF AND REPLACED WHEN THE UNIT IS CALIBRATED.				
	THE FUNCTION LABEL MUST BE REPLACED IF THE UNIT IS OPENED.				

TABLE 3 FINAL ASSEMBLY (CONT.)

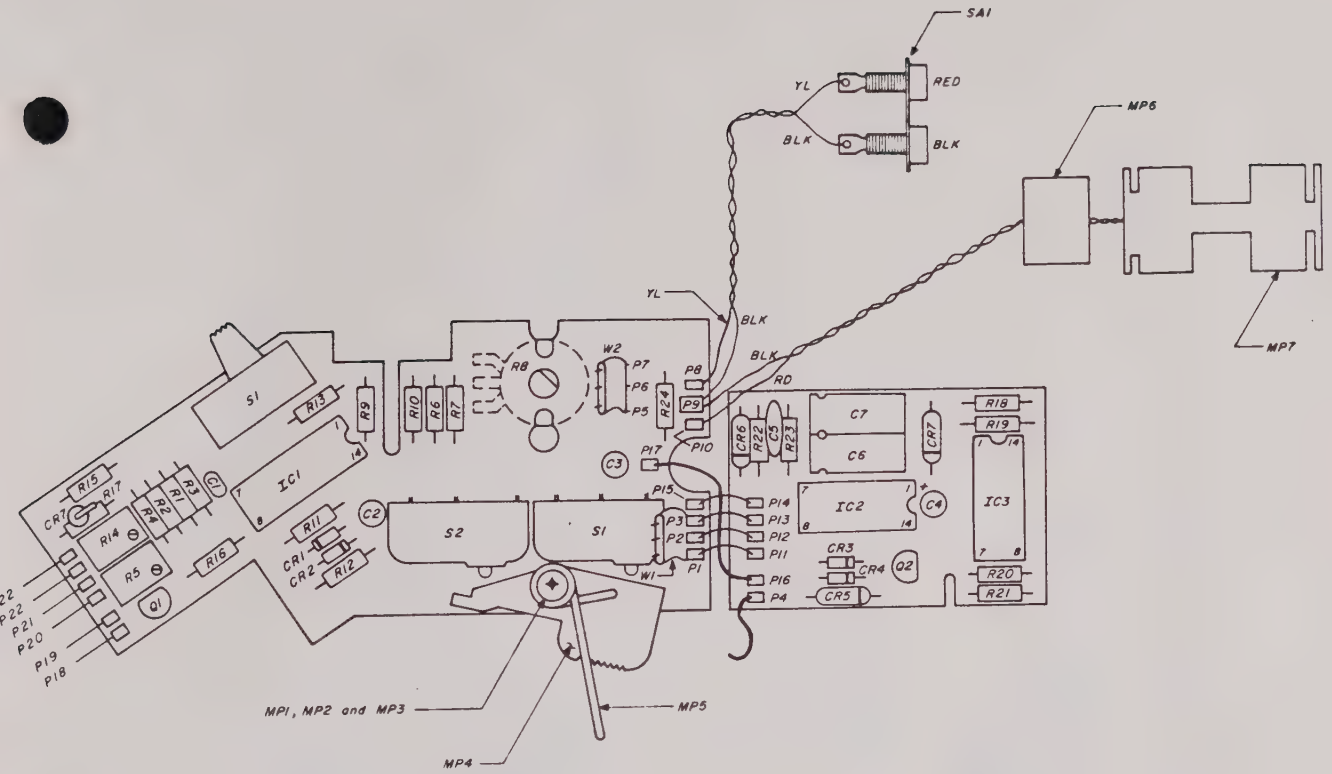


FIGURE 4 A1 ANALOG AND POWER PCB ASSEMBLY

UB-3986

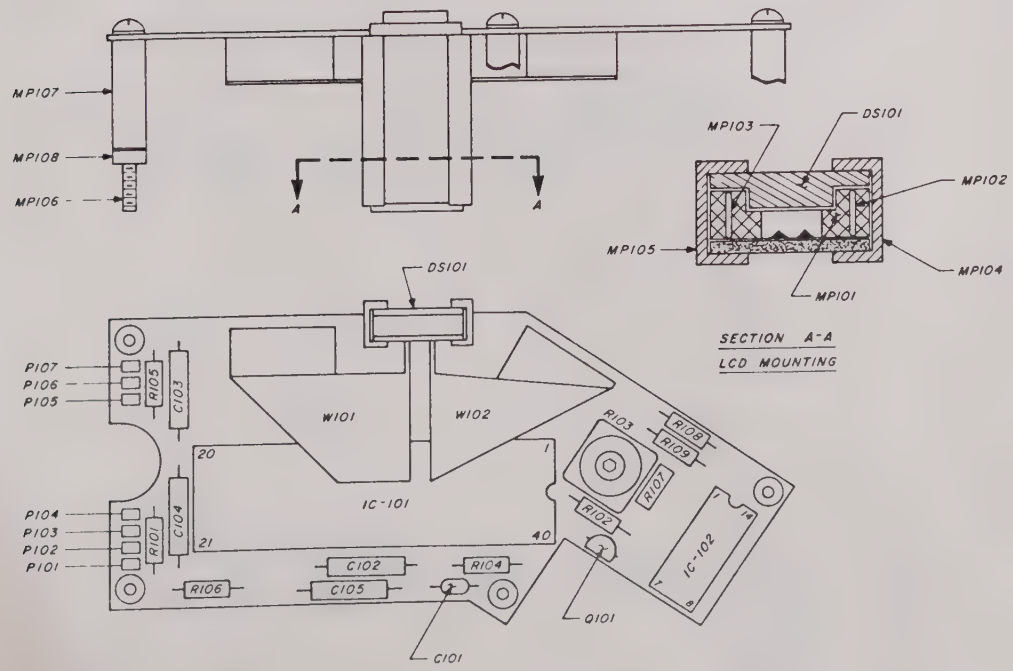
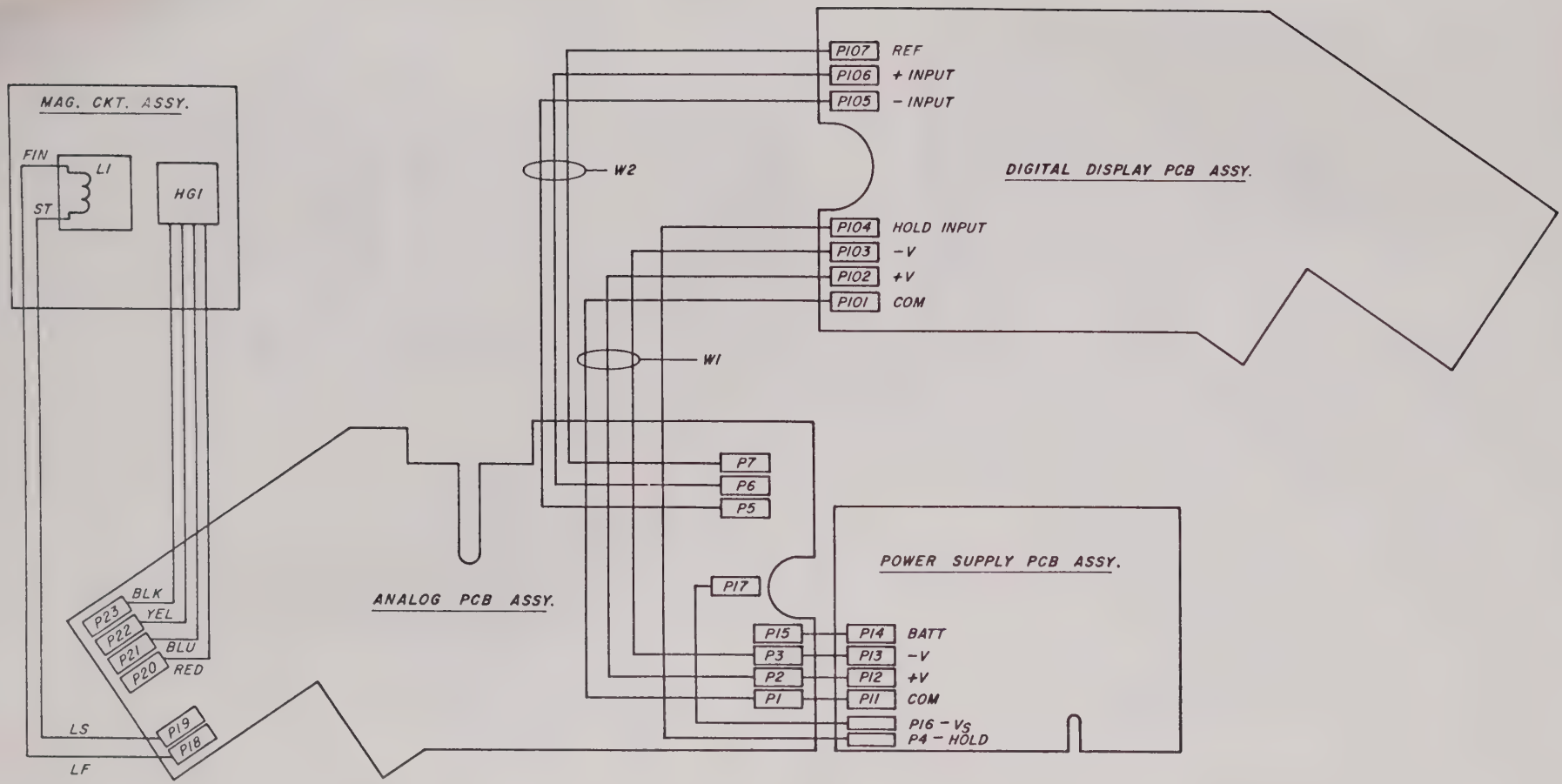


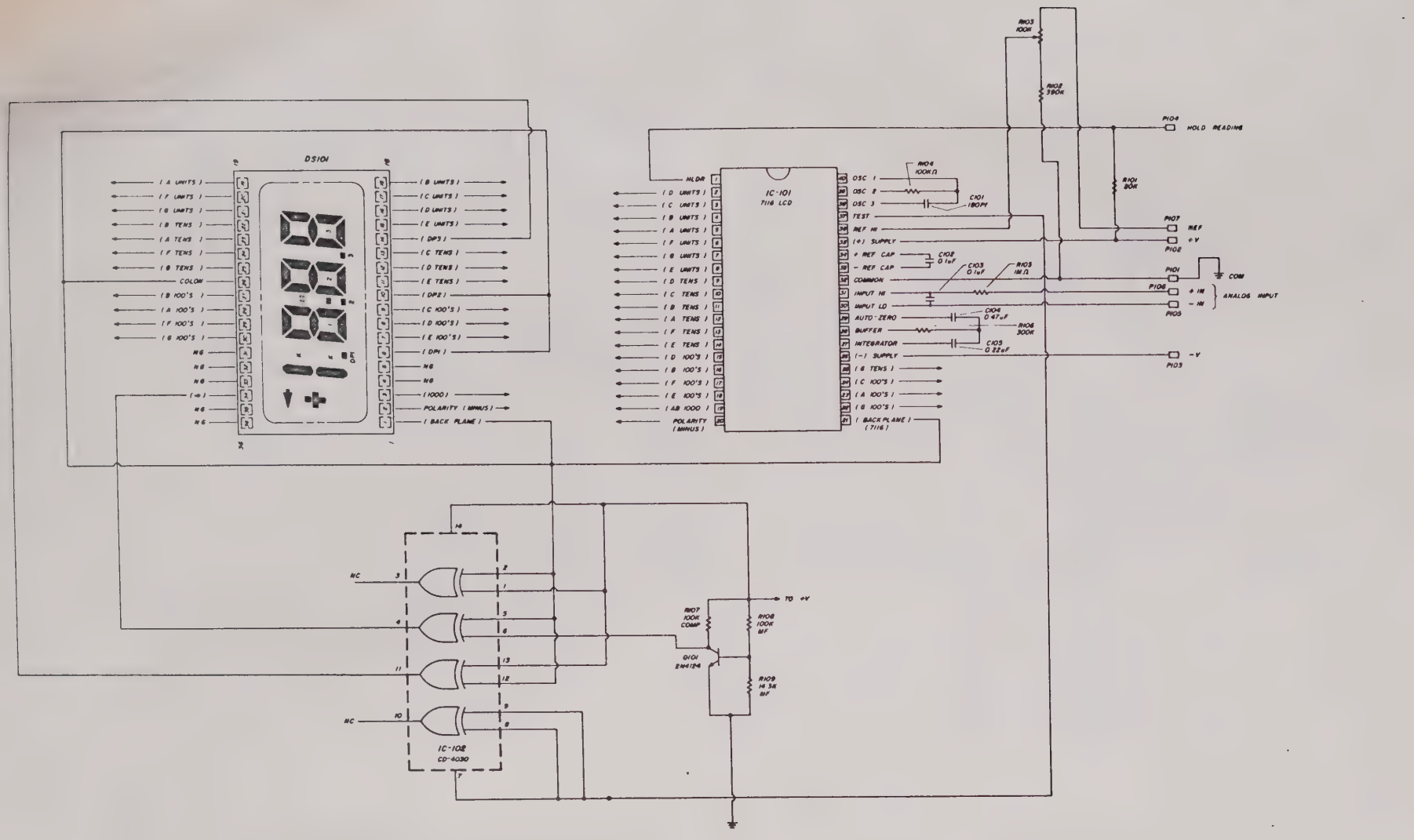
FIGURE 5 A2 DIGITAL DISPLAY PCB ASSEMBLY

UB-3984



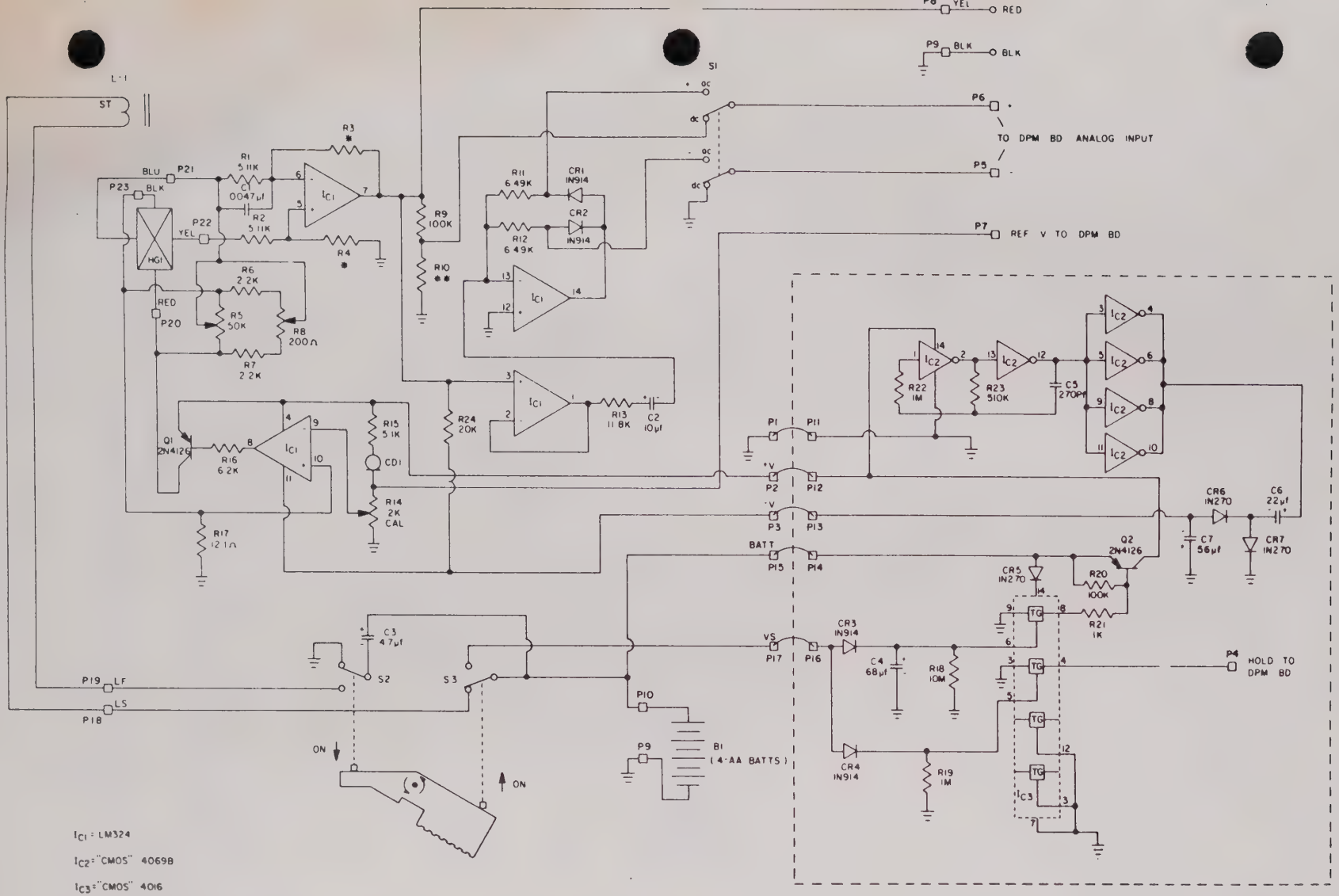
INTERCONNECTION WIRING DIAGRAM, GUN PLUS

UB-3981



DIGITAL PCB

UD-3723 A



I_{C1} = LM324

I_{C2} = "CMOS" 4069B

I_{C3} = "CMOS" 4016

* R3 and R4 = 165K

** R10 = 97.6K TO 100KΩ, FACTORY SELECTED

SCHEMATIC, ANALOG PCB

GUN PLUS MODEL CG-100D

DWG NO	REV
UC-3717	A

6. Install new LCD assembly as follows. (See Fig. II)

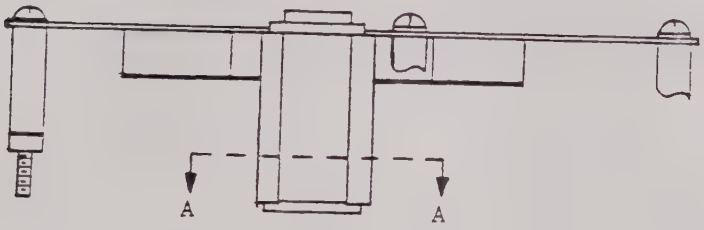
   A. Place new frame (1) into alignment holes on display PCB.

   B. Place new Zebra (elastomer) Strips (2) into slots of frame.

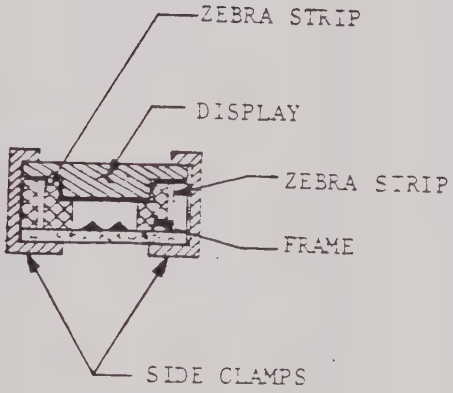
   C. Properly orient and install new LCD (3) into the frame.

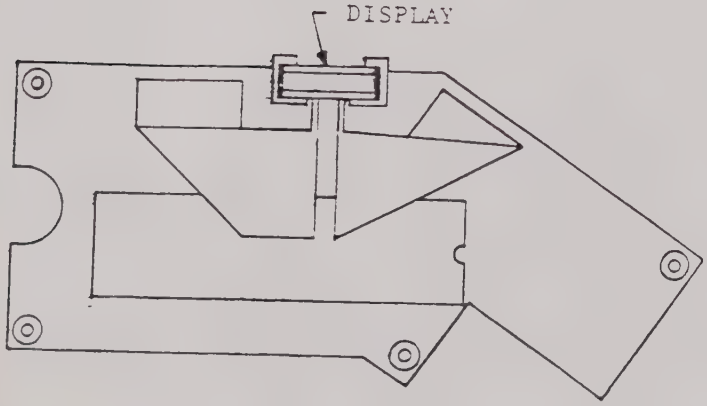
   D. Re-install "Black" LCD side clamps to display PCB assembly.

FIG. II



SECTION A-A
LCD MOUNTING





7. Re-install top PCB in proper position in gun.

   NOTES: 1. If the new assembly will not slip into the opening in the bottom PCB, remove side edge material as required.

   "DO NOT CUT INTO CLAD"

   2. Diagonal cutters may be used to cut the PCB material.

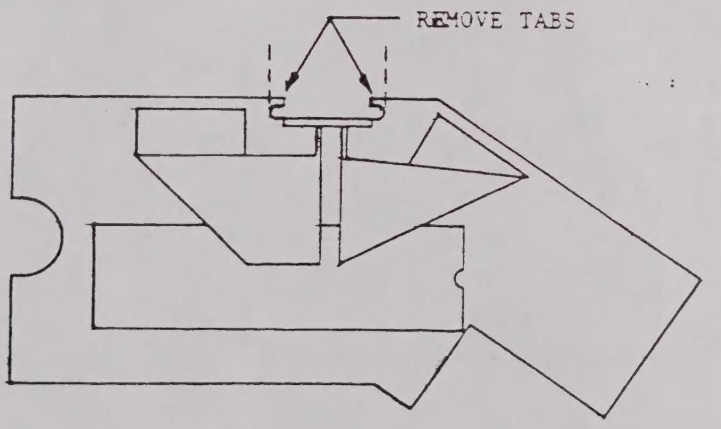
LTR	ECO	DESCRIPTION	BY / DATE	APR
A	4790	SEE E.C.O.	11-14-84 CM	MS

NOTE:

This instruction applies to all "GUNS" using LCD displays except model PG-200D with display printed circuit boards prior to revision B.

1. Parts are required as listed in reference (1) thru (3).
2. Remove or displace top PCB to gain access to the display.
3. Remove "Black" LCD side clamps from the display assembly.
4. Remove LCD, frame and elastomers (Zebra Strips) from the display PCB.
5. If the PCB assembly has small tabs, as shown in Fig. I, remove the tabs (cut off) to the area shown by dashed lines.

FIG. I



REF	QTY	DRAWING NO.	DESCRIPTION
3	1	30545	Display, Liquid Crystal QB-1761
2	2	31250	Zebra Strip, XA-0455
1	1	39411	Frame, PB-2357

MATERIAL & FINISH

ORLANDO, FLORIDA BELL INC

SCALE	DRN 28, Aug. 84 CRM
DEC ±	CKD 29 Aug 84
FRAC ±	APR 29 Aug 84

TITLE

"GUN" LCD
REPLACEMENT INSTRUCTIONS

SHT 1 OF 2

DWG NO. UA-4252

REV. A

ACCOPRESS®

25970	YELLOW
25971	BLACK
25972	LIGHT BLUE
25973	DARK BLUE
25974	LIGHT GRAY
25975	LIGHT GREEN
25976	DARK GREEN
25977	TANGERINE
25978	RED
25979	EXECUTIVE RED

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